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Leadership Professional Development for Diversifying the K-12 STEM Teaching Workforce

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Abstract

This study demonstrates a leadership professional development (PD) with a goal to build a coalition for attracting and retaining a diverse STEM teaching workforce in K-12 schools. In 2019, 111 participants of 21 teams from across the US participated in the leadership PD. Each team was comprised of 5-6 teachers and administrators representing their schools, districts, regions or states. The leadership PD enabled teams to share their problem of practice related to diversifying the teaching workforce and exchange ideas to resolve their challenges by working as a team with their matched mentor, who supported the group throughout the year. By the end of the 3-day workshop, each team developed a logic model that they could bring to their home school or district to take actions on promoting a diverse teaching workforce in their regions. In this study, we investigate the participants' attitudes and confidence toward the diversity in education; their thoughts about the leadership PD structure and their learning experiences; and the dynamics of an activity system that works to promote diversity in the teaching workforce, using the lens of the cultural-historical activity theory (CHAT).

Strand 11: Cultural, Social, and Gender Issues

Leadership Professional Development for Diversifying the K-12 STEM Teaching Workforce

Subject/Problem

Studies have highlighted the benefits of a diverse teaching workforce in K-12 schools. Researchers have found that it builds cultural bridges between home and school for students and promotes culturally responsive teaching (Brown, 2009; Villegas & Irvine, 2009; Weisman & Hansen, 2008). Additionally, there are positive associations between same-race teachers and diverse students' academic achievements (Egalite et. al., 2015; Klopfenstein, 2005). Minority students found teachers of color to be more accessible, caring, and more engaging (Sanders, 1998; Wilder 2000), and saw the same-race teachers as their role models (Eddy & Easton-Brooks, 2011; Pitts, 2007). Studies also have found that a diverse teaching workforce does not only benefit students of color but all students (Cherng & Halpin, 2016).

Currently, the Science, Technology, Engineering, and Mathematics (STEM) workforce is largely White (68%) with minorities making up a small fraction of the workforce (8% Black and 9% Hispanic) (National Science Foundation, 2017). This disparity is not an exception in the K-12 STEM teaching workforce. Studies have reported that minority students experience difficulties accessing higher education and the ability to persist to graduate in a STEM field (Moore, 2006; Museus et al., 2011), and minority pre-service teachers encounter barriers to entering the teaching field (Brown, 2014). In addition, there are higher attrition rates for in-service teachers of color than for White teachers (Achinstein et al., 2010; Kohli, 2019). In the public schools in the US, minority teachers make up less than 20% of the teacher population, with only 2% Black male teachers, while almost half of the student population is from one or more minority groups (Dixon et al., 2019). In addition, more than 40% of public schools in the US do not have a single teacher of color (National Collaborative on Diversity in the Teaching Force, 2004). This student-teacher diversity gap, or demographic discrepancy, is one of the reasons for the failure of schools to provide students of color with opportunities to learn (Cochran-Smith, 2004), creating an achievement and retention gap between White students and students of color (Haycock, 2001). The deficiency of same-race role models in school to students of color results in a decreased interest in learning and makes students of color less likely to choose careers in education (Gordon, 1994).

Increasing diversity, equity and inclusion in STEM education and providing lifelong access to high-quality STEM education to all Americans is one of the three main goals of the US government's five-year strategic plan for STEM education (National Science and Technology Council, 2018). This goal cannot be successful without diversifying the STEM teaching workforce in K-12 schools, where young students are significantly affected by their teachers. How, then, can we help to enhance diversity in the STEM teaching workforce in K-12 schools? Where does the work need to start, and how can it lead to systems change? How can leadership development be shaped to better support diversifying the STEM teaching workforce, and how does leadership development affect teachers and school leaders in their perceptions about diversity and in taking action to diversify the teaching workforce? And, what are the challenges that school leaders may confront while working toward systems change? These questions have not been fully answered in the field due to the lack of leadership development opportunities focusing on this matter.

In that, we invited teams of teachers and administrators to an annual leadership professional development workshop with the goals to build a coalition for attracting and retaining a diverse STEM teaching workforce and to develop action plans to move forward, with year-long mentor support. In this study, using the lens of *activity theory* (originated from Vygotsky, 1978) we share some of the preliminary findings of activity systems that the participating teams of the 2019 PD were engaged in to increase teacher diversity, and their learning experiences and attitude changes by attending the leadership professional development.

Design and Procedure

Setting and Participants

The goal of the annual leadership professional development (PD) workshop is to attract and retain a diverse STEM teaching workforce in K-12 schools. In 2019, 111 participants totaling 21 teams from across the US attended the PD. Each team was comprised of 5-6 teachers and administrators representing their schools, districts, regions or states. The PD program consisted of a 3-day workshop and year-long support from a matched mentor that began at the PD. The 3-day workshop provided several sessions allowing teams to share their problems of practice and exchange ideas to resolve their challenges as well as working time with their mentor. Each team developed a logic model to bring to their home school or district and guide

actions on promoting a diverse teaching workforce in their regions.

Research Questions and Data Collection

In this study, we investigated: 1) the participants' perceptions about diversity in education, 2) their thoughts about the leadership PD and their learning experiences, and 3) how an activity system works to promote diversity and what are the common challenges that each system faces. We collected mainly four different sets of data described below to answer those questions:

1) *The participants' pre/post attitudes survey*: The same questions were asked before (pre) and after (post) attending the 3-day workshop and at the end of the year (follow-up post), to discern changes in the participants' perceptions about diversity in education. The survey consisted of 18 Likert-scale items in four constructs (workplace diversity; diversity in students – student diversity and student learning; self-efficacy of fostering cultural diversity; and thoughts about administrative support for diversity). 2) *The participants' perceptions about their learning experience and thoughts about the PD program*: A questionnaire consisting of both Likert-scale items and open-ended questions was administered at the end of the second and third day of the 3-day workshop. It asked about their learning experience at the workshop and thoughts about the program structure. 3) *Each team's logic model*: Each team developed a logic model during the 3-day workshop describing their plan for actions. This logic model was used as baseline data of where they were at and what they planned for. 4) *Mentor and team lead quarterly reports*: Each team's mentor and team lead were asked to submit a quarterly report about their progress and challenges. The mentor reports and team lead reports along with the logic models were triangulated to increase reliability and validity of analysis.

Analyses and Findings

Participants' Perceptions about Diversity in Education

Among the 111 participants, 61 respondents were paired between the pre (before the workshop) and post (after the workshop) attitude survey. The follow-up post survey at the end of the year is recently collected, therefore it is not included in this proposal. Descriptive statistics and paired-samples t-test were performed with the 61 paired samples between pre and post. The descriptive statistics showed higher means in the post than in pre in most items. The difference

of the overall mean for the paired samples was statistically significant between post (M=4.46, SD=0.326) and pre (M=4.27, SD=0.357); t(60)=4.601, p=.000. In the construct level, there was a statistically significant difference in their perceptions of student diversity (M_{post}=4.70, SD_{post}=0.454; M_{pre}=4.54, SD_{pre}=0.532), t(60)=2.019, p=.048; diversity affecting student learning (M_{post}=4.77, SD_{post}=0.308; M_{pre}=4.63, SD_{pre}=0.435), t(60)=2.675, p=.001; and self-efficacy of fostering cultural diversity (M_{post}=4.46, SD_{post}=0.468; M_{pre}=4.16, SD_{pre}=0.597), t(60)=5.067, p=.000. However, their perception about diversity in the workplace and their thoughts about administrative support for diversity did not show a statistically significant difference. This suggests that the participants had a more positive attitude toward diversity after attending the workshop than before, and especially their attitudes toward diversity of students and their self-efficacy of fostering cultural diversity had significant increases after attending the workshop. However, this also suggests, while it needs more investigation, that it may take more time and effort to have their attitude change on workplace diversity, with more active involvement of administrative supports.

Participants' Perceptions about their Learning Experience at the PD Program

At the end of the second and third day of the 3-day workshop, the participants were asked to respond to their learning experience and thoughts about the program structure. The surveys consisted of both Likert-scale items and open-ended questions, and the mixed-method was utilized to analyze the data using descriptive statistics and grounded theory approach (Corbin & Strauss, 2008). Some of the commonly emerging themes found from the 111 participants are listed below with some participants' quotes.

Realized the importance of communication and persistent effort: They realized how important it is to communicate with stakeholders and administrators and how persistent efforts are needed through conversation to lead systems change.

"*Importance of "talk to talk" again and until is really needed" (O01);*

"Listening and patience were reexamined for me and made me reflect on the importance of both." (A02);

"How to be more specific in delivering messages to stakeholders with trying to establish relationships/partnerships with them." (T03)

Development of a clear vision and planning was helpful: They liked the clear vision and tangible action plans that they developed at the workshop to bring to their school or district to implement.

"The strategies used to teach and reinforce development of the logic model were excellent. I will repeat

them with others" (O02); "clearer approach to developing a sound logic model." (O03); "I really like the logic model and will use the model for other changes/planning processes in other aspects of leading our school." (A04); "Creating the logic model plan. I like that I can use this model with other problems within my school or classroom." (T04)

Valued the planning time with colleagues: Each day of the workshop, the participants were given time to work with their colleagues as a team. It was found to be very valuable for them because they do not often have such a time to meet between teachers and school/district leaders to discuss and make plans together.

"The most useful part was the time to do the work. Oftentimes we are given a task but never the time to meet with each other in order to complete." (T05); "The most useful part was the team planning time which often is rare in education." (A06); "Allow our team to meet outside of XXX to plan, meet others who are focused on similar initiatives. The tools and strategies were relevant, and the feedback was substantive. The passion that leadership brings to this initiative, and long term commitment to help make all youth and our communities better." (O07)

Sharing with people from other regions experiencing the same issues is very useful: By attending the workshop, the participants were reminded that other schools, districts and regions also had the same issues. They reported that it was very useful to remember that others also had similar problems and to share their thoughts and feedback with each other.

"The opportunity to glean info from others that were having similar issues with recruitment" (A08); "Most useful part was being able to flesh out our ideas by talking with other groups and getting their feedback" (T09)

These themes are evolving as we delve into more data. We will present the developed themes in more detail along with the leadership development program structures at the meeting.

Activity System for Systems Change to Diversify STEM Teaching Workforce

The participants developed a logic model at the 3-day workshop and they returned to their region to take action with it, but many factors were interwoven when they carried out their plans. Such factors and the interactions between them can be explained with the Cultural-Historical Activity Theory (CHAT), which describes human's activity in social and cultural contexts (Vygotsky, 1978; Engeström, 1987). We used the lens of CHAT to better understand the complex human activities in a system in this study.

Figure 1 shows an activity system, representing the PD participants' activities and interactions in the system and their practices to achieve their goals throughout the year. In the

model, subjects are the team members who participated in the PDt and were motivated toward a purpose or attainment of the object. The object is the goal of their team for the year to diversify the STEM teaching workforce in their school or district. A logic model is a socially shared material, i.e. tool, which the subjects use to attain the object. In pursuing the plans, the participants encounter social norms or rules. There are formal and informal regulations and cultural contexts that affect the subjects who engage in an activity. The community is a group or organization that subjects belong to. In this case, it is their school or district in the region, which includes its administrators, HR personnel, parents, and students as the community members. The division of labor is the shared participant responsibilities or roles in the activity, determined by the community. The outcome is what subjects draw as the result of their actions, driven by the object. In future activities, the outcome can affect the subject's decision by encouraging or discouraging the subject's participation.

At the workshop, the participants (*subjects*) identified issues and plausible solutions and developed their goal and plans (*object*) using the logic model (*mediating artifact/tool*). The logic model acted as a psychological tool that helped the participants' consciousness develop and as a technical tool that was shared and valued within the activity throughout the year. In pursuing the object, the participants were challenged by *rules*, such as school policies, social or cultural norms or regulations. The subjects communicated with their *community* members to advance their goals. Some teams had good communication and built a good relationship with their community members, while some other teams had difficulty reaching out and getting support from them. When the object was supported by the community, especially school/district administrators or decision makers, the subjects were able to take action, not merely limited to operational levels but taking actual action that can link to activity (Leont'ev, 1978; Wilson, 2006), by organizing roles and responsibilities to achieve the goal. When their work (*division of labor*) was appropriate to the original object, they could achieve their desired outcome.

Throughout all these procedures, some systems may have achieved their goals or become robust, while the others may not have followed their plans or become unsustainable, and it would explain the different outcomes between the teams.

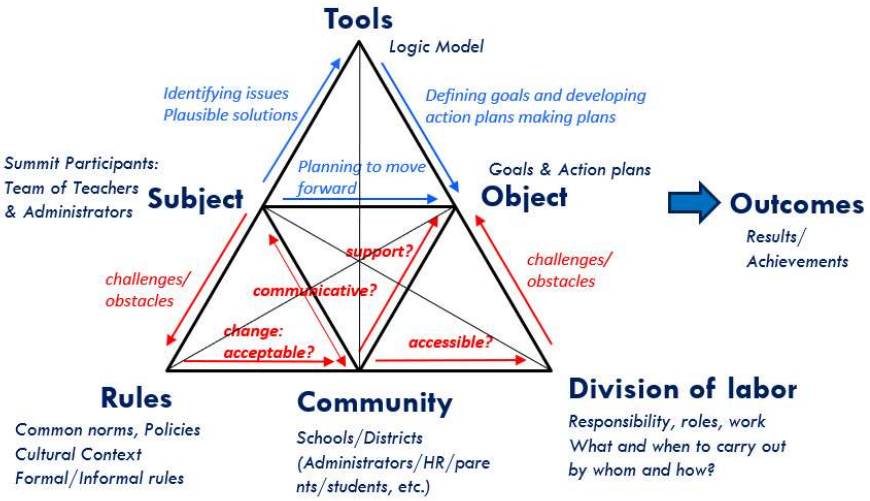

Figure 1. Activity System for Systems Change to Diversify K-12 STEM Teaching Workforce

Discussion/Contribution

While diversity issues become more critical in US education, there have been a lack of leadership professional development programs to discuss the common issues and to find solutions focusing on diversifying the teaching workforce in K-12 schools. This diversification should be the most fundamental starting point to untangle the complicated problems. This study shows that the participating teachers and administrators significantly increased their confidence to foster cultural diversity at the leadership PD. Furthermore, they tended to be more open-minded to student diversity and student learning at the culturally diverse environments, while demonstrating a relatively passive attitude toward the workforce diversity itself. This finding needs further investigation to verify participants' perceptions on diversity in students and their learning versus the workplace to see if they truly had a somewhat contradictory mindset.

The activity theory has become popular in education research in the past two decades, however, its usage in K-12 education has been limited (Nussbaumer, 2012). Using the lens of the CHAT, this study investigates the dynamics of an activity system to promote systems change of diversifying the K-12 teaching workforce, which has been largely unanswered in the field yet. This study will contribute a better understanding of what interactions in an activity system are taking place, how the system could move forward to achieve the goals, and what challenges they may have faced in the procedures of promoting the diverse K-12 teaching workforce.

General Interest

The NARST members will find this study interesting in terms of learning the dynamics of activity systems to promote STEM teaching diversity in K-12 schools, which is one of the critical diversity issues in US education. The members will find information about what teachers and administrators are thinking regarding diversity in education, and how leadership PD could affect their attitudes on diversity. Some researchers will also find information about how the CHAT is used as an analytic tool, and some others will find ideas of how to structure such leadership PD in their education setting. Most of all, this study will provide an opportunity for the NARST members to reflect on the challenges and root causes for the lack of K-12 teacher diversity and discuss how to work together to resolve this issue.

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